A New Drifting Reduction for Transcoding MPEG Video

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Abstract

In this paper, we propose a drifting reduction for open-loop MPEG video transcoding with coefficient dropping. The basic idea is to decode those dropped out pixels to form a drift reference frame, and change the quantization indices in the current macroblock accordingly. Although this method cannot completely eliminate the drift errors, however simulation results demonstrate its effectiveness on reducing the drift errors by improving the objective measures, e.g., PSNR and the most of the drift operations can be done in frequency domain resulting in the fast transcoding processing.

1. Introduction

In this paper, we propose a new drifting reduction method for open-loop MPEG video transcoding as shown in Figure 1. Without loss of generality we assume the input video bitstream is generated by MPEG based coding scheme, i.e., motion compensated block-based DCT transform coding. By decoding the dropped off DCT coefficients during transcoding, a drift reference frame is generated. With this drift reference frame, drifting errors can be reduced by changing the quantization index of the current MB. In other words, the new quantization index takes the drift error into account by refining itself. Note that since it is based on the open loop solution, there is no need to do motion search again. Instead, the same motion vector is applied. With the motion vector and the drift reference frame, the quantization indices can be changed based on the motion vector and the drift reference frame. The details of the proposed scheme are presented in the following sections.

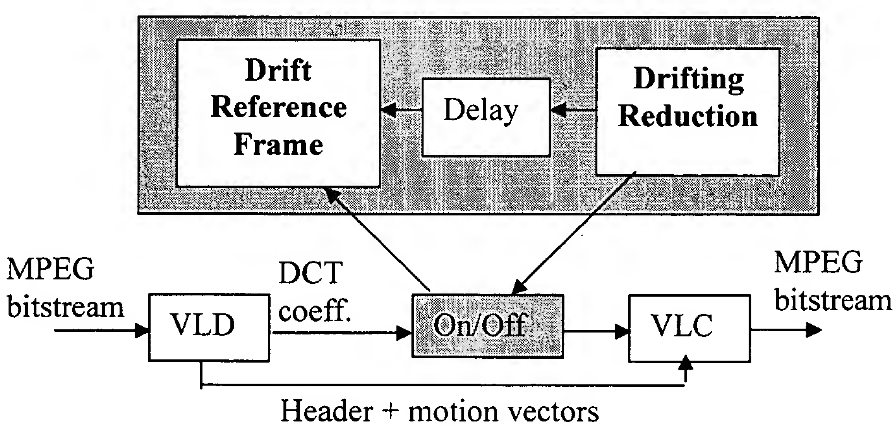

Figure 1 Open-loop video bitrate transcoding with drifting reduction.

2. The Proposed Drifting Reduction Method

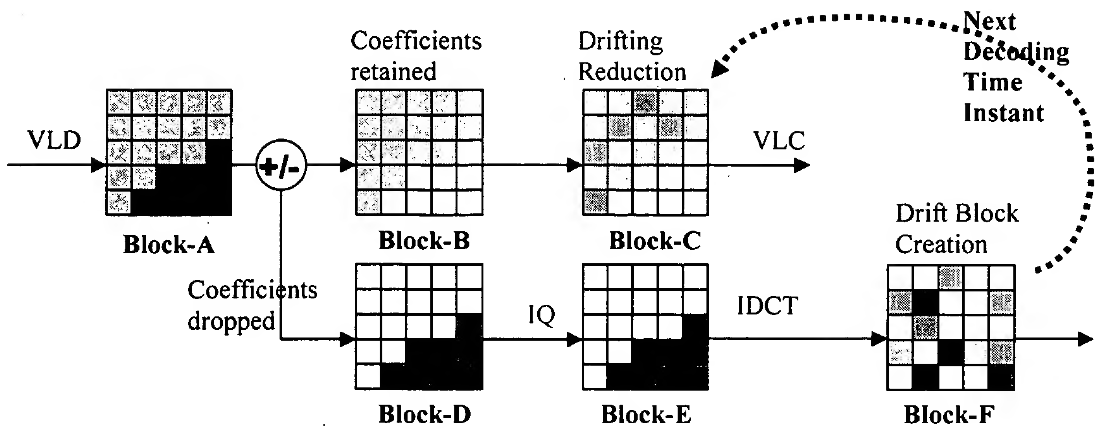

Figure 2 The proposed method is consisted of two major components: (1) drift reference creation and (2) drifting reduction

The proposed method is consisted of two components: (1) drift reference creation and (2) drifting reduction, as shown in Figure 2. A MPEG video bitstream is firstly variable length decoded (VLD) as shown in Block-A Then two separate processing paths are conducted to do the drifting reduction in the upper path, and the drift reference creation in the lower path. In the upper path, block-B denotes the retained coefficients. The drifting reduction method is then applied so that some quantization indices may be changed to reflect the drifting reduction. The details of the drifting reduction will be explained later. The new Block-C is variable length encoded. Note that all of these operations are still done in DCT domain. The lower path is to generate the drift reference. The drifting error problem mainly results from DCT coefficients dropped off. To diminish the drifting effect, the drift reference block is created by storing those pixels in spatial domain. As shown in Block-D, some coefficients that are dropped off (dark squares) are inverse quantized into Block-E, and then inverse DCT transformed into pixel values, as shown in Block-F. At this point, the drift is obtained in spatial domain. For each block (Macroblock), the above drift reference process is conducted to form a drift reference frame, as shown in Figure 3.

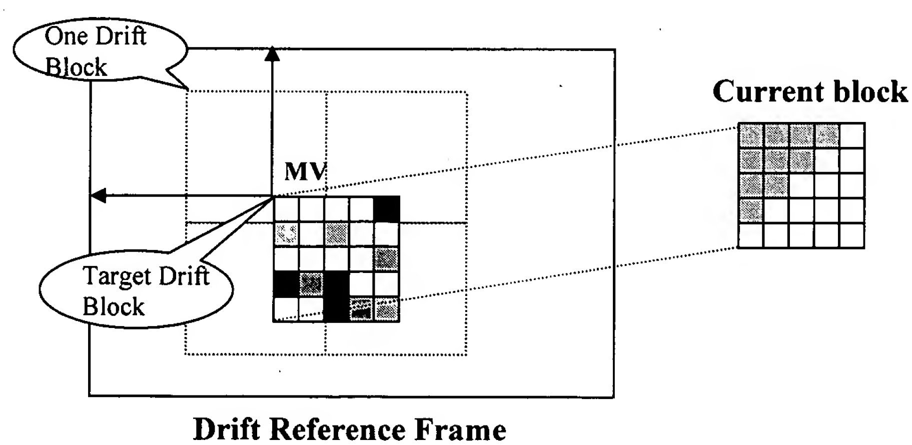

Figure 3 The creation of drift reference frame that is derived based on the previous reference frame.

Now the details of drifting reduction are elaborated as follows. Assume the current (macroblock) block is VLDed and its motion vector is MV(x,y). Based on the MV(x,y), the corresponding drift block is located in spatial domain as shown in Figure 4. Since the current block is in DCT domain, to facilitate the drifting reduction operations, the drift reference block is DCT transformed and quantized based on the quantization matrix used in the current block.

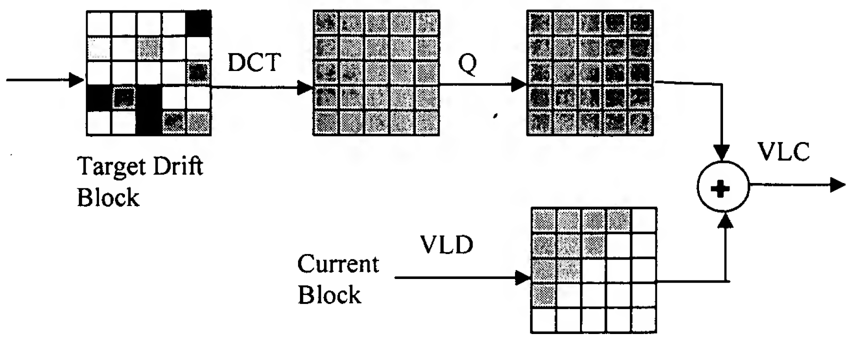

Figure 4 The proposed drifting reduction method.

As shown in Figure 4, after the DCT and quantization, the drift reference block is one-by-one correspondence with the current block. Then co-located quantization indices are summed up together as a new quantization index in the newly created block that is, in turn, VLCed. The main advantages of the proposed drift reduction method include (1) motion vector remains unchanged (2) DCT domain drift reduction, and (3) fast creation of drift reference frame in spatial domain.

3. Simulation Results

To evaluate the performance of the proposed drift reduction method, the simulation is set up in the following way. Pixel values in the range of 110 to 150 are randomly selected to form a 16x16 frame as a reference frame, and an 8x8 block is similarly generated to form a current block with its motion vector MV(x,y), where x and y both are 3 for its simplicity. Note that the motion vector in our simulation is not necessarily pointing to the best-matched block in the reference frame. We also assume the cut-off point for the DCT coefficients dropping in higher frequencies is 10. i.e., only ten DCT coefficients are retained. We compare the both PSNR values of current block without any drift reduction and with our drift reduction. Each PSNR value in the table is the average value over 5000 simulation runs.

# of retained DCT coefficients	PSNR without Drift Reduction	PSNR with Drift Reduction
4	19.16	19.71
6	18.47	19.73
8	18.26	19.47
10	15.39	18.78
12	15.52	18.92

Reference

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